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ABSTRACT

Despite recent advances in instructional technology, there still exist substantial gaps between technology's promise and its achievement. This situation is partly due to the fact that teachers who have a clear conception of the teaching-learning interaction are not involved in the implementation of technological innovations. Teachers and teacher educators can ameliorate this situation by developing an adequate conception of the educative act itself. One such model would view it as an intentional act of probabalistic nature, consisting of four dimensions. The purposes dimension involves the clear stipulation of the changes in the learner's behavior which are expected, while the procedures dimension encompasses the instrumentalities introduced to effect these changes. The information dimension is comprised of the experiences and data used to justify educational procedures, realizing that only probable validity is possible. Finally, the measurement and evaluation dimension permits the teacher to test his educative hypotheses. Such a framework assigns educational technology to the procedures dimension and enables the teacher to evaluate it in terms of his compatibility with the stipulated purposes, its appropriateness to individual learner needs, and its utility in producing the desired learning. (PB)

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TECHNOLOGY, TEACHING AND SANITY

(Invited Address, World Assembly of International Council on Education in Teaching, Nairobi, Kenya, July 27, 1973)

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"Things are in the saddle and ride the back of mankind," wrote the American poet, Emerson, in 1846 and a large proportion of contemporary educators in diverse tongues, cry "Amen and Alas!," as they try to avoid or escape from the cold electronic clutches of modern instructional technology. This paper is addressed to such educators--to their disquietude and their long winter of discontent with "the things of learning," to use a recent engaging nomenclature.[1] However, lest these few sentences and my tribal membership mislead you, I must warn that I come not as a protecting and comforting knight-errant but to point a stern, reproving finger at those who teach and those who teach teachers.

EDUCATIONAL TECHNOLOGY IS BOOMING

During the past two decades we have witnessed gigantic developments in the development and application of electronic[2] instrumentalities for learning, together with the "software" accouterments. The rate of this development has increased exponentially through the present and can easily be projected to continue undiminished into the foreseeable future. Major funding and sponsoring agencies (e.g., the United States Agency for International Development, UNESCO, the United Nations Development Program, The World Bank) have included instructional technology in their major agenda. Many countries have instituted or are instituting national

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ETV systems, among them two particularly interesting ones on the African continent--Ivory Coast and Niger. A spate of literature and specialized journals in instructional technology has emerged, and in all major languages. Well-funded research in this general field has been carried out and continues in Universities, Centers and Institutes around the globe. The vocabulary and grammar of education are heavily infused with the terms, metaphors and logics of engineering, electronics and mechanics.[3]

BUT

The foregoing comprise a sample of phenomena suggesting that instructional technology is clearly among us, large and hyperactive, is presumed to be helpful and represents a considerable investment of capital, time, energy, intelligence--and sometimes passionate commitment. And, yet, as one observor notes;

> The claims that educational technology would serve as a catalytic agent for overall educational reform--upgrading the quality of instruction, reforming curriculum, reaching large numbers of students, equalizing educational opportunity and reducing unit costs of instruction--with few exceptions have not materialized. School systems and educational opportunity ... remain essentially the same. There has been some expansion and incremental reform, but few fundamental changes in the philosophy, structure, content and outcomes of schooling.[4]

Or, again, in the language of James Koerner:

> In the 1950s predictions were widely and confidently made that education by 1970 or 1975 would be revolutionized by technology--that is, by the new technologies of communications that are generally lumped under the name "educational technology." Leaders and so-called futurists from the knowledge industry, from government, from education, and, I regret to say, from foundations joined in these rosy prognostications. Lately this enthusiasm has given way to embarrassment and disenchantment, as many a corporation has found its Edsel in educational technology. The metaphor is imperfect. The Edsel at least ran; the public just wasn't buying. Educational technology to date cannot be said even to "run."[5]

Clearly, there appears to be a contradiction between claims and performance and an extensive gap between promise and achievement. Two executives of the Ford Foundation, which has supported and plans to continue its support to instructional technology, wrote earlier this year that "[d]espite the depth of feeling that [instructional technology] evokes and its increasing prominence, the field is enshrouded in vague definitions, hazy purposes and murky evaluation."[6] The ETV analyses conducted by Carnoy,[7] an economist specializing in educational development, indicate that, in both cost-benefit and cost-effectiveness terms, it is difficult to defend the results of most programs thus far and among his findings is the following: "... the cost of ETV schooling is much higher per pupil than classroom teacher schooling and the performance of pupils is not significantly or consistently better when teachers are simply retrained to use more effective curricula. Teacher retraining costs are usually a small fraction of the cost of operating an ETV system."[8]

What is wrong? Why has a huge mountain labored so hard to produce only a few mice? The diagnoses are many--some of them relevant, others probably self-serving rationalizations. It is charged, for example, that teachers are not adequate to these electronic gifts from heaven. This may be true but I am mindful of what the humorist, James Thurber, once said: "A word to the wise is not sufficient if it doesn't make any sense." Some feel that the difficulties arise from meanly motivated promotors of the hardware, who pursue their mission with fanatic zeal. There probably are too many such salesmen, who fit nicely the definition of a fanatic as one who does what he knows the Lord would do if given all the facts of the case. Another diagnosis is that both educators and technologists have been more fascinated with the medium than with the message. And so on through a long series of suspicions.

Of the relevant criticisms, let me briefly mention only two, which I select because they pertain centrally to the argument I wish to make about the classroom teacher's role in all of this: (1) While the hardware of instructional technology may be universally relevant and exportable, the content and process (i.e., "the software") is not; yet a substantial number of early ventures in educational technology (and some even now) involve content and processes defined by persons in Culture-X for application on persons in Culture-Y. This surely is a losing game. (2) The second diagnosis is not unrelated to the first. It is what Robert Locke calls "the cart-before-the-horse approach" to instructional technology: "instead of concentrating so single-mindedly on products for sale to schools, we should concern ourselves with the processes by which skills and knowledge are acquired."[9] In another place, he joined with Engler to add that "very little ... analysis ... had been in terms of how well [technology] can be adapted to an instructional strategy that takes into account the differences in learning style and rate.[10]

The two criticisms, then, are that technology in education often has been an irrelevant intrusion, addressing instructional purposes other than those entertained by a particular school and with assumptions about learners that do not fit the particular learner characteristics confronted by the technology in a given time and place. These deficiencies are remediable; they are not inherent limitations of the medium--as is witnessed by the developmental work of Wilbur Schramm and the research efforts of Patrick Suppes, to mention only people at my own institution with well-earned international reputations in this field.

Nonetheless, despite increased pedagogical piety and prayer, a critical lacuna remains--the intelligent participation of the teacher.

I now turn to the gravamen of my concern and to the stern reproving finger promised in my initial comments.

NOSTRA MAXIMA CULPA!

My thesis is simple--perhaps arrogantly so: (1) Since the effectiveness of instructional technology is a function of its ability to engage specific intended schooling outcomes in specific contexts and with specific learner background and process characteristics, the teacher (who resides in and arbiters these specificities) must be centrally involved. (2) On the other hand, teachers generally tend to have somewhat the same mindlessness about the teaching-learning process as the "technologists" whom they decry, suspect, criticize and fear. If I am somewhat correct on the second statement (which is frankly exaggerated), the difficulties with instructional technology are merely a microcosm of a fundamental and continuing deficiency in our profession.

We are told that teachers resist engagement with the new technologies, that they fear and are threatened by them, that they see in them a dissolution of "the essence of professional being."[11] I interpret that this "resistence" and "hostility" of teachers often is generated out of the inadequacy of their frames-of-reference for the act of teaching. As a particularly perceptive instructional technologist notes, "[t]he reason so little instructional technology is used in education today is that its visible faults always end up being compared with the teacher's invisible virtues."[12] Without an explicit, defensible frame-of-reference any instrumentality will be seen as wanting and as an unwelcome intrusion. Those of us who teach or who prepare teachers have culpability and responsibility.

A PATH TO SECULAR SALVATION: TEACHING AS HYPOTHESIS-MAKING

Having pointed the finger of criticism, I am under some moral obligation to be constructive. What frame-of-reference is required to intelligent conduct of an educative act? The answer comes with the question: any frame-of-reference that is explicit, rational, critical and reasonably exhaustive of the phenomena called "teaching." Immodestly and for what it is worth, I suggest one that I have described earlier and elsewhere.[13] I find it useful. Whether others do or not is less important than that it may clarify my concern and prompt the development of alternative satisfying paradigms for teaching--whether the teacher be a warm-blooded human or an impersonal bit of hardware-software. I offer, then, a paradigm for which I call "a normative conception of the educative act." It is frankly a description of what should be rather than what is characteristic of teaching behavior. As I said earlier, it is simple--much too simple for this audience but I ask for your tolerant patience while I sketch it out. While I shall make little or no reference to educational technology in what immediately follows, please bear in mind that I consider the absence of this (or an alternative) rational frame-of-reference precisely what is most difficulty-producing in the effective application of technology to instruction.

Any frame-of-reference involves some stipulations and assumptions. In this case two must be made explicit: a distinction and a controlling assumption. My controlling assumption is the logical principle that empirical predictions can have only probable validity--they cannot be statements of certainty. While that assumption may be tolerable to all, you probably will not share the next stipulation--in which case you will

simply have to go off and develop your own frame-of-reference based on the formulation you prefer. I refer to the distinction between "teaching" and "learning," terms and processes so often confused and confounded in educational discussion as to make constructive thinking most difficult. The distinction is between what is intended to be learned, and what is in fact learned. Both phenomena occur in any educational enterprise but the first (the intentions) are the starting point--or so I assume. That is to say, "teaching" is an intention act; someone's intentions are involved. Clearly as Cremin notes,

> What is taught is not always what is desired, and vice versa; what is taught is not always what is learned, and vice versa. Moreover, there are almost always unintended consequences in education; indeed, they are frequently more significant than the intended consequences. Hence, educational transactions are often marked by profound irony (John Calam noted one such irony in Parsons and Pedagogues 1971: the Society for the Propagation of the Gospel in Foreign Parts mounted a massive educational effort to hold the American colonists to kind and church, and thereby spread literacy at precisely the time the colonists were being inundated with a literature of revolution).[14]

My assumptions, then, are that the educative act, whether mediated by a person or a machine, must be seen as an intentional act and of a probabilistic nature--the latter point I will elaborate later.

I conceptualize this educational act as comprising four simultaneous dimensions, all of which must be present consciously at any instant in time if teaching is to be effective.

THE PURPOSES DIMENSION

The first dimension of the educative act is suggested by the stipulation that the educative act is intention and, more specifically, that it is assumed to be instrumental in generating desirable changes in the behavior of the learner. By definition, therefore a sine qua non in any

professional action of the teacher is a conscious awareness of what he considers these desirable expectations to be. Or, to put this in more familiar language, the responsible educator is always acting in terms of educational purposes that he considers worthy.

But desirability is not the only requirement for the purposes dimension; the educator's awareness of the desired expectations must also be clear. The necessity for clarity and the difficulty of achieving it are frequently underestimated. You can satisfy yourself on this point by examining the educational objectives, written or verbalized, held by a teacher at any grade level in a local school. The odds are that you will find the statements highly generalized and ambiguous in nature--statements which, to rephrase Gilbert and Sullivan, "say nothing in particular but say it very well." Considerable clarity is needed to illuminate effectively the specific decisions, judgments, and procedures comprising education. Such clarity is not achieved easily and is found only rarely. Its absence seriously precludes the rationality of the educative act. Some of the greatest failures of modern educational technology occur because clear and agreed upon purposes have not been set forth.[15]

THE PROCEDURES DIMENSION

Another salient dimension of the act of educating encompasses the actions performed by the educator to bring about the change in his pupil that his purpose proposes. That is, this dimension comprises the procedures the educator undertakes, expecting that they will result in the desired learning. What are they? The answer is fairly obvious in some cases: for instance, planning lessons, assigning homework, selecting curriculum materials, and grouping pupils for instruction. Others, such as smiling--

or frowning--at a pupil's response, planning the new school building, and sending periodic reports to parents, may be less obvious. All these, however, are rational decisions deliberately made in the light of anticipated changes in the behavior of the learner.

Such an orientation is far from representative of the way in which teachers actually behave. Many educators, as distinguished from our ideal one, see no necessary relation between some of their procedures and the purposes dimension. It is this very discontinuity between procedures and purposes that obscures the relevance of research and suggests the need for the kind of conception of the educative act that we are now elaborating.

Thus far, then, we have identified two logical dimensions of the educative act: the kinds of changes desired in pupils, the purposes dimensions, and the instrumentalities introduced by the educator to bring about these changes, the procedures dimension. At this point our ideal teacher would verbalize any given moment of teaching thus: "I use this procedure because it will help the pupil change in these directions." Although our hypothetical teacher is consciously relating procedures to purposes, the putative relationship is not yet clear. Something is missing, the justification for assuming that the particular procedure will result in the desired learning.

THE INFORMATION DIMENSION

Why does the educator use some procedures and not others when he is attempting to bring about a particular kind of change in the behavior of a learner? We can quickly dismiss random selection as an explanation for this choice, since such an explanation would be psychologically naive. Presumably, rather, the educator uses a particular procedure because

information on hand leads him to conclude that it may be effective in generating the particular behavior changes he desires. The body of the information that generates the procedures dimension varies a great deal in kind. It includes, for instance, the teacher's recollections of his previous experiences with educational methods, reports of the professional experiences of other educators, generalizations produced in behavioral and biological sciences, recommendations of experts, and implications of a particular theory of human behavior. The information also varies with respect to level of specificity. On the one hand, it includes propositions about learners and learning in general and, on the other hand, it also involves highly particularied observations about the specific characteristics and idiosyncrasies of a given pupil, school, and community. All these generalizations, experiences, and data used by an educator to justify an educational procedure constitute the information dimension of the educative act.

With the addition of this third dimension, our ideal teacher would verbalize any given moment of teaching in a somewhat different way: "This information (information dimension) suggests that this procedure (procedures dimension) will lead to the achievement of these purposes (purposes dimension)." Although this formulation of the act of teaching goes beyond the recipe approach, it is not yet a professionally responsible one. Before the conception becomes intelligent, it must be cast in terms of a crucial characteristic of the information dimention. At this point we turn to what is the defining core of our conception of the educative act.

How certain can the educator be that his procedure will result in the particular behavior change for which he hopes? The answer to this

question may be intuitively obvious: The educator cannot be certain that his procedure will be effective. But why? An immediate explanation lies in the present status of our knowledge in the behavioral sciences. As I noted earlier, present knowledge about learning and the conditions that produce learning is far from adequate. However, there is another and much more basic reason for this uncertainty in the educative act; the assumption that prediction has only probable rather than certain validity. This assumption, which stipulates an important qualification regarding the nature of the information dimension, permits us to conceptualize the educative act as an act of inquiry.

The problem can be stated as one involving the phenomenon of prediction. The purposes dimension of the educative act--that is, the behavior changes desired--refers to events that have not yet occurred. The educator, at any moment of the educative act, is attempting to bring about behavior not present in the learner. He is predicting that his procedures will produce the desired changes in the pupil. Now, what can we say about the validity of prediction? As was noted before, although we sometimes can speak with certainty regarding something that <u>has</u> occurred, logically we can only talk about the probability of the future occurrence of an event.

Furthermore, the information dimension in the educative act consists mostly of statements of probability. Even the very best research in psychology, for instance, does not purport to tell a particular teacher, in a particular situation, with particular purposes in mind, what will happen with his particular learner; it is the teacher's task to make an inference about the probability of its truth in the specific situation. If this is so, what can we say about educational procedures? Clearly,

if the information dimension consists of probability statements and if the teacher is attempting to predict for a future situation, the conclusions drawn by him regarding the best methods for achieving his purposes are themselves probability statements.

Statements about teaching procedures must, therefore, be thought of as predictions of probable value and probable effect. The educator's operations are hypotheses and, like any hypotheses, have to be tested in the crucible of experience; they cannot be assumed to be valid. The value of any operation is not fully known until we determine the extent to which it actually is associated with accomplishing the specific purposes to which it is assumed to be relevant. Furthermore, a particular educational procedure retains this hypothetical character, even if it has been demonstrated to be effective for other persons and in earlier situations. In effect, then, any educational decision or procedure, at the moment of application, must be viewed with tentativeness. Although the procedure, at that point, is an empirical hypothesis--that is, it predicts something will happen--the results are not yet known. The degree of confidence that the educator can invest in this procedural hypothesis attests to the clarity of his educational purposes, the reliability of the information used, and the adequacy of the inductive and deductive logic he used to connect the two.

With this understanding, our ideal teacher now would revise his verbal description of his conduct at any given professional moment in this manner: "On the basis of this information, I hypothesize that this procedure will lead to the achievement of these behavior changes."

THE MEASUREMENT AND EVALUATION DIMENSION

Given the hypothetical nature of the educative act, the final dimensions of our conception emerge necessarily. If we accept the argument that educational methods are to be thought of as hypotheses, we are obliged to assess the degree to which these hypotheses are good ones--that is, whether the methods result in the behavior changes expected. The rigorous testing of hypotheses is frequently a complex procedure and may require knowledge and time usually not available to the educator in a classroom or administrative office. However, the responsibility for initial and provisional evaluation of these educational hypotheses can be assumed conscionably by any educator. He may determine the degree to which the hypothesized behavior changes manifest themselves in the behavior of pupils. If the expected and hoped-for changes are found to follow the procedures used, the educator has no immediate reason to reject the procedures, although (and this is an important caveat), he should not conclude that the changes occurred because of the operations he performed. If, on the other hand, the expected changes do not occur, or do not occur in the degree anticipated, he may conclude that the hypothesized procedure was inadequate under the given conditions. He then reexamines the logical process by which he formed the hypothesis, including the question of whether he had sufficient relevant data at the time, and formulates a new hypothesis.

The educator who does not assume this responsibility for evaluating the adequacy of his own procedures is left with no rational basis for modifying his procedures or for knowing that he should modify them. The alternative is to rely on dogma, authority, or luck. Such uncritical reliance, however, is markedly incongruent with membership in any profession.

Assessing educational hypotheses involves two identifiable operations: first, determining the status of the learner with respect to the behavior change in question and, second, evaluating the adequacy of this status. The first is the operation of observation and measurement; the second, the operation of evaluation. To state these operations in another way, the first is concerned with what change has taken place in the learner, and the second asks whether the change is consistent with the directions specified in teaching objectives and in sufficient degree. The distinction may help to make clear an important implication of our paradigm of the educative act: The basic professional relevance of measuring school achievement is that the data produced enable the educator to evaluate his own procedures and to modify them, if necessary. This is not the usual stance taken by educators. Unfortunately, too many of them see the measurement of achievement and the evaluation of this achievement as relevant only to the obligations of judging the pupil and informing the pupil, his parents, and the school records of this judgment.

A careful study of the foregoing discussion, will show that the educative act can be thought of as comprising an uninterrupted cycle of inquiry. The educator, with a clear awareness of the behavior changes desired and the most reliable information available, hypothesizes some procedures that are probably effective in producing the behavior changes. These procedures are put into effect; the behavior changes in the pupil associated with, and following the use of, these procedures are noted and compared with the changes expected; if the expected behavior change does not occur or occurs in insufficient degree, new hypotheses are generated, using all available data, including the new information produced by the measurement and evaluation operations; these new hypotheses

are put into effect--and so on without end. Those of you who are familiar with Michael Scriven's[16] distinction between summative and formative evaluation will recognize the later in what I have just said.

SO WHAT?

What has my little model to do with technology, teaching and sanity? I suspect that you have inferred the answer already. In order to stay professionally sane, one must think of the technology of instruction as belonging in the procedures dimension of the educative act. It is an instrumentality of the educators' intentions and, as such, must be rationalized in terms of the educators' purposes, utilized in terms of local learner characteristics and evaluated in terms of the degree to which the intended learnings occur. However, such is not typically the case and I attribute the current low effectiveness of technology to the absence of an <u>educative</u> rationale in its use. Those who promote, install and operate these technologies are often to blame for a serious naiveté about teaching and learning. But more culpable are the teacher trainers who prepare teachers inadequately. Unless teachers are helped to develop a rational conception of teaching, which makes them <u>participants</u> in the process of developing and evaluating professional knowledge, technology (whether television or book) will continue to be a loser in any cost-benefit analyses--and schools will continue to be at the mercy of the latest glib promoter of the latest electronic gadget.

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